

# ML

## Lithium Manganese Dioxide Rechargeable Battery



# LITHIUM MANGANESE DIOXIDE RECHARGEABLE BATTERY

## Safety Instructions

This battery contains lithium, organic solvents, and other combustible materials. For this reason, improper handling of the battery could lead to distortion, leakage\*, overheating, explosion, or fire, causing bodily injury or equipment trouble. Please observe the following instructions to prevent accidents. (\* Leakage is defined as the unintentional escape of a liquid from a battery.)

### ⚠ Warnings — Handling

#### ■ Never swallow.

Always keep the battery out of the reach of infants and young children to prevent it from being swallowed. If swallowed, consult a physician immediately.

#### ■ Do not replace.

Depending on the battery manufacturer, there might be major differences in performance even among the same types or models of batteries. If you are an equipment manufacturer and need to replace the battery, please use a new one of the same type and same model as the existing one. Because this is a rechargeable battery, its characteristics are completely different from a primary battery even though their shapes are alike. If a primary battery is installed in the circuit in place of a rechargeable battery, gas could be generated or the primary battery could be short-circuited by charging. This could lead to distortion, leakage, overheating, explosion, or fire. Please design your equipment so that the end user cannot replace the battery by mistake.

#### ■ Never use two or more batteries connected in series or in parallel.

If batteries are connected together, it is very difficult to design a circuit to observe whether or not the batteries are charged at specified voltage or current as described in "Warning -Circuit Design".

#### ■ Never reverse the positive and negative terminals when mounting.

Improper mounting of the battery could lead to equipment trouble or short-circuiting. This could cause distortion, leakage, overheating, explosion, or fire.

#### ■ Never short-circuit the battery.

Do not allow the positive and negative terminals to short-circuit. Never carry or store the battery with metal objects such as a necklace or a hairpin. Do not take multiple batteries out of the package and pile or mix them when storing. Please be careful when installing the battery not to short-circuit it with metal portions of the equipment. Otherwise, this could lead to distortion, leakage, overheating, explosion, or fire.

#### ■ Never heat.

Heating the battery to more than 100 deg. C could increase the internal pressure, causing distortion, leakage, overheating, explosion, or fire.

#### ■ Never expose to open flames.

Exposing to flames could cause the lithium metal to melt, causing the battery to catch on fire and explode.

#### ■ Never disassemble the battery.

Do not disassemble the battery, because the separator or gasket could be damaged, leading to distortion, leakage, overheating, explosion, or fire.

#### ■ Never weld the terminals or weld a wire to the body of the battery directly.

The heat of welding or soldering could cause the lithium to melt, or cause damage to the insulating material in the battery, leading to possible distortion, leakage, overheating, explosion, or fire. When soldering the battery directly to equipment, solder only the tabs or leads. Even then, the temperature of the soldering iron must be below 350 deg. C and the soldering time less than 5 seconds. Do not use a soldering bath, because the circuit board with battery attached could stop moving or the battery could drop into the bath. Moreover do not use excessive solder, because the solder could flow to unwanted portions of the board, leading to a short-circuit or charging of the battery.

#### ■ Never allow liquid leaking from the battery to get in your eyes or mouth.

Because this liquid could cause serious damage, if it does come in contact with your eyes, flush them immediately with plenty of water and consult a physician. Likewise, if the liquid gets in your mouth, rinse immediately with plenty of water and consult a physician.

#### ■ Keep leaking batteries away from fire.

If leakage is suspected or you detect a strong odor, keep the battery away from fire, because the leaked liquid could catch on fire.

#### ■ Never touch the battery electrodes.

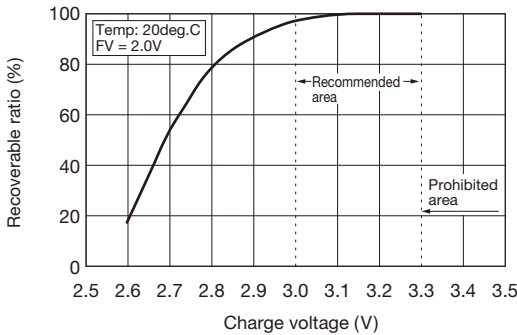
Do not allow the battery electrodes to come in contact with your skin or fingers. Otherwise, the moisture from your skin could cause a discharge of the battery, which could produce certain chemical substances causing you to receive a chemical burns.

**Warnings – Circuit Design**

**Never set the charge voltage above 3.3V.**

Charging at a higher voltage could cause the generation of gas, internal short-circuiting, or other malfunctions, leading to distortion, leakage, overheating, explosion, or fire. For details, see the recommended circuits below.

Fig. 1 Charge Property



**Always charge at the nominal currents shown below.**

Large surges of current could degrade the battery’s characteristics, leading to distortion, leakage, overheating, explosion, or fire. To avoid excessive current at the initiation of charging, make sure to attach a protective resistor for current control. See the recommended circuits below.

Table 1 Nominal Charge Current by Model

Model	ML2032	ML2016
Charge Current	2mA or lower	2mA or lower

**Recommended circuits**

Please refer to the representative basic circuits shown below. If you have any questions about circuit design, please feel free to contact Maxell.

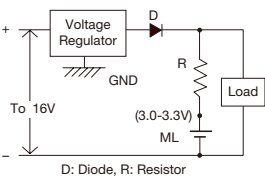


Table 2 Example of resistors

Model	Output Voltage of Voltage Regulator	
	3.1V	3.2V
ML2032	>550 ohm	>600 ohm
ML2016	>550 ohm	>600 ohm

**(How to select a protective resistor for the current control)**

The maximum charge current flows in the battery when charged at an end voltage of 2V. Therefore, the value of the resistor is calculated using this equation:

$$R \geq ((\text{Output Voltage of Voltage Regulator}) - 2) / (\text{Nominal Charge Current})$$

For example, the S-812C series, which has a maximum input voltage of 18V, or the S-817 series with a maximum input voltage of 10V (Seiko Instruments Inc.) can be used as a voltage regulator.

Note 1: If the main power source voltage is stable, the charge voltage can be allotted from main power source divided by the combination of resistors.

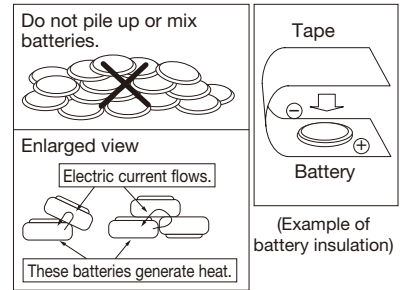
Note 2: Because the battery height must be changed by charge and discharge cycle, place a minimum of 1mm space between the battery and device or chassis.

**Never over-discharge the battery.**

If the battery is over-discharged to below the specified voltage (2.0V), it may not be rechargeable.

**Warnings – Disposal**

The battery may be regulated by national or local regulation. Please follow the instructions of proper regulation. As electric capacity is left in a discarded battery and it comes into contact with other metals, it could lead to distortion, leakage, overheating, or explosion, so make sure to cover the (+) and (-) terminals with friction tape or some other insulator before disposal.



**Caution – Handling/Storage**

**Never expose the battery to ultrasonic sound.**

Exposing the battery to ultrasonic sound may cause short-circuiting because the inside material is broken into pieces, leading to distortion, leakage, overheating, explosion, or fire.

**Never subject the battery to severe shock.**

Dropping, throwing or stomping on the battery may cause distortion, leakage, overheating, explosion, or fire.

**Use the correct battery suitable for the equipment.**

The battery may not be suitable for the specific equipment due to the using conditions or type of equipment. Please select the suitable battery according to the handling instructions of the equipment.

**Never use or leave the battery in a hot place such as under the direct rays of the sun or in a car in hot weather.**

If you do, this may cause distortion, leakage, overheating, explosion, or fire.

**Never allow the battery to come in contact with water.**

If it does, this may cause the battery to rust or lead to distortion, leakage, overheating, explosion, or fire.

**Never store the battery in a hot and humid environment.**

Otherwise it may cause battery performance deterioration, deformation, leakage, overheating, or explosion.



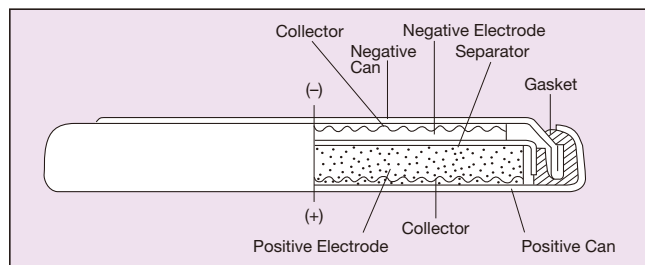
### Overview

The coin type lithium manganese dioxide rechargeable battery is a small, lightweight rechargeable battery. This battery employs specially treated manganese dioxide for the positive material and a lithium-aluminum compound for the negative material. A specially formulated organic electrolyte is also used, yielding excellent discharge characteristics with low self-discharge.

### Features

- Approx. 2.5V operating voltage**  
 The operating voltage is about twice that of nickel cadmium rechargeable batteries. Displays a high discharge voltage of 2.8V when at 10% of nominal capacity (depth of discharge is 10% or less), when charged at 3.0 to 3.3V.
- Superior charge/discharge cycle characteristics**
- Wide -20 deg. C to 60 deg. C usable temperature range**  
 Demonstrates stable operating voltage in temperatures as low as -20 deg. C and as high as 60 deg. C.
- Low self-discharge and superior leakage resistance**  
 Self-discharge at 20 deg. C is no more than 2% per year. Supplies a nominal capacity of about 95% even when stored at 20 deg. C for roughly five years (according to accelerated test conducted by Maxell). And since organic electrolyte is used, the battery has superior leakage resistance.
- Excellent floating characteristics**  
 A specially formulated organic electrolyte is employed to provide stable discharge characteristics even if charged for a year at 3.3V at 20 deg. C (according to accelerated test conducted by Maxell).
- Excellent high rate discharge characteristics**

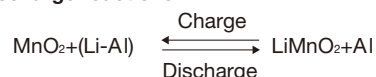
### Construction



### Principle and Reactions

The coin type lithium manganese dioxide rechargeable battery is a 3V battery using specially treated manganese dioxide for the positive material, a lithium-aluminum compound for the negative material and a specially formulated organic electrolyte solution.

#### ■ Charge/Discharge reactions



### UL (Underwriters Laboratories Inc.) Recognized Components

Recognized models: ML2032, ML2016  
 Certification Number: MH12568

### Applications

- OA Machines (Fax, Copiers, Printers)
- Notebook PCs
- Desktop PCs
- Camcorders
- Digital Still Cameras
- Watches
- Medical Instruments, Cash Registers
- FA Instruments (Measuring Instruments, Onboard Microcomputers, Sensors)
- Electronic Meters (Water, Gas, Electricity)

### Products

Model		ML2032	ML2016
Nominal voltage (V)		3	3
Nominal capacity (mAh)*1		65	25
Nominal discharge current (μA)		200	200
Charge, discharge cycle lifetime	Discharge depth of 10%	1,000 (6.5mAh discharge) (total capacity 6,500mAh)	1,500 (2.5mAh discharge) (total capacity 3,750mAh)
	Discharge depth of 20%	300 (13mAh discharge) (total capacity 3,900mAh)	500 (5mAh discharge) (total capacity 2,500mAh)
Operating temperature range (deg. C)		-20 to +60	
Dimensions*2	Diameter (mm)	20	20
	Height (mm)	3.2	1.6
Weight (g)*2		3.0	1.8

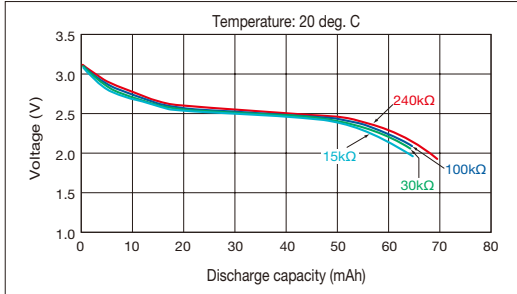
\*1 Nominal capacity indicates duration until the voltage drops down to 2.0V when discharged at a nominal discharge current at 20 deg. C.

\*2 Dimensions and weight are for the battery itself, but may vary depending on terminal specifications and other factors.

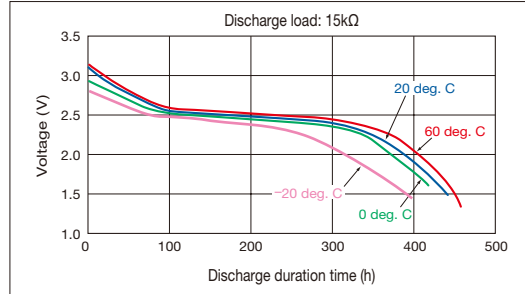
• Data and dimensions are just reference values. For further details, please contact your nearest Maxell dealer or distributor.

Characteristics (ML2032)

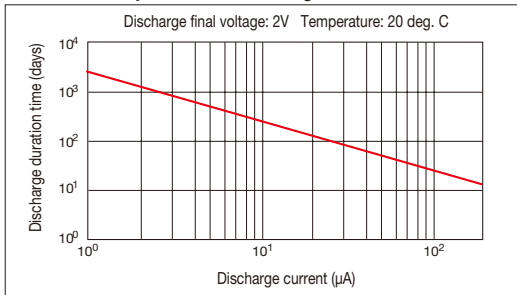
Discharge Characteristics



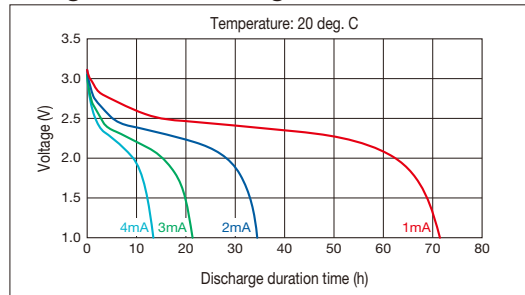
Temperature Characteristics



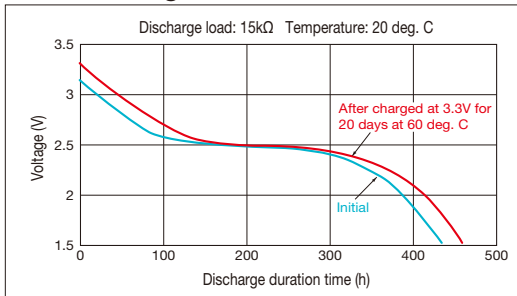
Relationship between Discharge Current and Duration Time



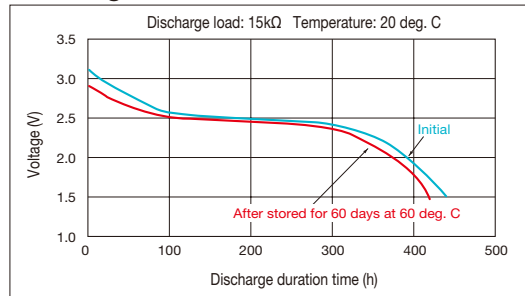
High Rate Discharge Characteristics



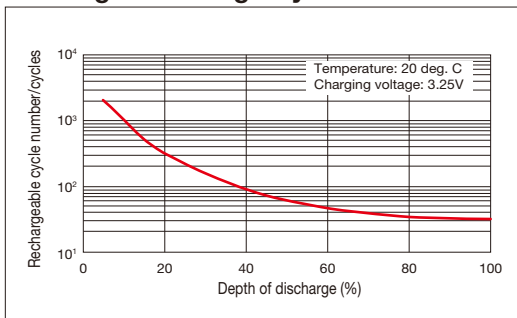
Over Charge Characteristics



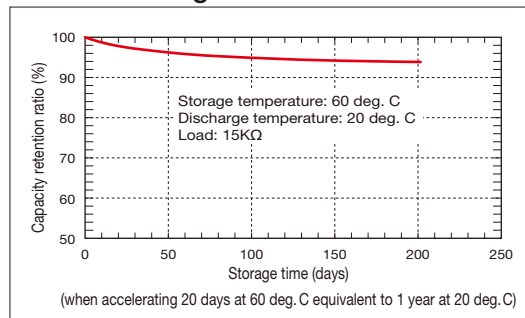
Storage Characteristics



Charge/Discharge Cycle Performance



Self-discharge Characteristics



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## External Dimensions with Terminals and Wire Connectors (unit : mm)

ML2032 T6	ML2032 T6 TUBE	ML2032 T14	ML2032 T25
ML2032 T32	ML2032 T17	ML2032 T26	ML2032 WK
			<p>Housing: HNC2-2.5S-4 (Hirose) Contact: HNC-2.5S-C-B (02) (Hirose) Lead wire: AWG26 UL1007</p>
ML2032 WK2	ML2016 T6	ML2016 T25	ML2016 T17
<p>Housing: ZHR-2 (JST) Contact: SZH-002T-P0.5 (JST) Lead wire: AWG26 UL1571</p>			
ML2016 T26	<p> <span style="background-color: #ffffcc; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span> : Horizontal &amp; Through hole Type  <span style="background-color: #c8e6c9; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span> : Vertical &amp; Through hole Type  <span style="background-color: #bbdefb; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span> : Wire connector Type  <span style="background-color: #e0e0e0; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span> : Tin plating         </p> <p>The above are examples. Processing to meet customer requests is possible.</p>		

Visit our website for more information

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Go to: Products > Rechargeable Batteries > ML (Coin Type Lithium Manganese Dioxide Rechargeable Battery)